Fomites: from colonization to the risk of infection on tourniquets in Nursing Practice

João Manuel Garcia Nascimento Graveto, MSN, PhD, RN
<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>João Graveto, RN, MS, PhD</th>
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<tbody>
<tr>
<td>Conflicts of interesse</td>
<td>None</td>
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<tr>
<td>Employer</td>
<td>Nursing School of Coimbra</td>
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<td>Sponsorship/Commercial Support</td>
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<tr>
<th>Faculty Name</th>
<th>Pedro Miguel Silva, RN</th>
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<tr>
<th>Faculty Name</th>
<th>Marta dos Santos Costa, RN</th>
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Session Goal

The presentation of this research will provide new data to understand the instituted practices in nursing care of the use of tourniquets

Session Objectives

To understand the occurrence of fomites in hospital environment, specifically on tourniquets;
To know actions and strategies to decrease complications involved in tourniquets using;
INTRODUCTION

Nosocomial Infections → Massive problem in Health Institutions

Risk Factores to acquire hospital infections:

Endogenous

Exogenous

Vale and Dinis (2011) define fomites as a surface or object, porous or non-porous, contaminated with pathogen microorganism, acting like a vehicle to transfer infections.

These objects are daily use in the hospital environment and their use becomes a risk as they may cause an infection to the patients.
The focus of this research → **Tourniquets**

- We should look to the reused tourniquets like a fomite, because these kind of tourniquets are the more used in hospital daily practice.

Tourniquets are used in the more common and invasive procedure in the hospitals (cannulation and for getting blood samples).
**METHODOLOGY**

- Integrative Literature Review (ILR) according to *Cochrane Handbook*.
- **Aim:**
  - To understand the occurrence of fomites in hospital environment, specifically on tourniquets;
  - To know actions and strategies to decrease complications involved in tourniquets using;

The Research was made between 2010 and 2015. The chosen methodology was the PI[C]OD.
<table>
<thead>
<tr>
<th>Concept</th>
<th>P</th>
<th>Participants</th>
<th>Who was been studied?</th>
<th>Nurses and Health care workers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Interventions</td>
<td>What as been done?</td>
<td>Interventions to prevent contamination of tourniquets; Interventions to prevent transmissions of several pathogen microorganism presents on tourniquets.</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Outcomes</td>
<td>Results, effects or consequences</td>
<td>Good practices that reduced infections rates associated with fomites;</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Design</td>
<td>Types of researches included.</td>
<td>Descriptive, quantitative and experimental Researches.</td>
<td></td>
</tr>
</tbody>
</table>
The research question who guided this research is:

Which are the practices related to tourniquets handling [I] (known as objects with high risk of contamination), used by nurses or health care workers [P], with consequences in prevention of nosocomial infections [O]? ' 

To perform the ILR it was previously established criteria's for inclusion and exclusion of the Researches .
<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Inclusion</th>
<th>Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researches</td>
<td>Researches dated between 1(^{st}) of January 2010 to 19(^{th}) of May 2015; Articles in Portuguese, Spanish and English; Full text articles.</td>
<td>Research dated before the 1(^{st}) of January 2010; Articles in other languages; Articles without full text; Articles related to pediatrics area.</td>
</tr>
<tr>
<td>Participants</td>
<td>Nurses; Health care workers that use tourniquets.</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Prevention; Procedures; Autonomous and interdependent Nursing actions; Effective measures proven; Awareness of the risk infection to fomites; Contributions to acquire good practices to prevent infection.</td>
<td>Lack of specify information about the theme.</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Results about the Nursing practice and other health care workers; Aplicability of the interventions.</td>
<td>Non-conclusive results.</td>
</tr>
<tr>
<td>Design</td>
<td>Descriptive, quantitative and experimental Researches.</td>
<td>Results without research methodology.</td>
</tr>
</tbody>
</table>
Researches identified through database searching and Portuguese Institutional and International Repositories (n= 168)

Inclusion and Exclusion Criteria Applied (n= 66)

Selected Articles (n= 9)

Included Articles (n= 5)

Excluded Articles (n= 4)

Excluded Articles (n= 57)
<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinto, A.; Phan, T.; Sala, G.; Cheong, E. Siarakas, S. &amp; Gottlieb, T (2011, September 5).</td>
<td>'Reusable venesection tourniquets: a potential source of hospital transmission of multiresistant organisms'.</td>
</tr>
<tr>
<td>Mehmood Z.; Mubeen S.M.; Afzal M.S. &amp; Hussain Z. (2014 September).</td>
<td>'Potential risk of cross-infection by tourniquets: a need for effective control practices in pakistan'.</td>
</tr>
</tbody>
</table>
OUTCOMES

S1 E1 → Authors: Pinto, A.; Phan, T.; Sala, G.; Cheong, E. Siarakas, S. & Gottlieb, T (2011, September 5).

• Sydney Teaching Hospital;
• Collected 100 samples of reusable tourniquets from different hospitals wards;
• Divided in two moments.

1st Moment
• The colonisation rate from 100 tourniquets were 75%.

2nd Moment
• Tourniquets were colonized with more than one microorganisms.
  • 61% of reusable tourniquets were colonized with various species of microorganisms that aren’t associated with skin flora but with the hospital environment.

Authors estimate that 6% of hospitalized patients will acquire a hospital infection.
• Research done by the infection control team;
  • In 30 operation rooms and 2 different hospital buildings;
  • They cut tourniquets in two different pieces;
  • The first half part was disinfected with alcoholic solution 83% and washed with distilled water;
  • The second half part were pressed against a culture solution;
  • It was applied forms to professionals in order to understand hand hygiene when tourniquets are used.

Conclusions

• The disinfected tourniquets had no microorganisms.
• Before the application of alcoholic solution, tourniquets were contaminated.

Forms

• 37% of the team do hand-washing with soap and alcohol before the cannulation;
• 44% do hand-washing occasionally;
• 19% of the team don't do any of these procedures.
Research conducted at the Microbiology and Orthopedic departments of a tertiary hospital;
• 16 samples from orthopedic reusable tourniquets – labeled from 1 to 16;
• The inner and outer areas of tourniquets were identified with proximal and distal extremity;
• The odd numbers: half were imbied with *salvone* solution and the other with *sterillium* solution;
• The pair numbers didn’t have any treatment.

**Conclusions**

• All tourniquets were colonized with microorganisms, with 15 to 68 per area;
• The inner (1459 colonies) and proximal (1382 colonies) areas were more contaminated than the outer (1030 colonies) and distal (1107 colonies) areas.

After treatment with antiseptic the number of colonies reduce:
• 92.18% with *Salvone*;
• 95.70% with *Sterillium*. 
• Research done in Pakistan;
• Swabs made from 100 tourniquets: 40 from public hospitals and 60 from private hospitals;
• Harvesting carried out on both sides of tourniquets from the distal and proximal regions.

Outcomes

From 100 samples, 51 had bacteria colonies:
• 23/40 samples from public hospitals;
• 28/60 samples from private hospitals.

*Staphylococcus aureus* Methicillin resistant (MRSA):
• More prevalent in public hospitals (18, 2%);
• Less prevalent in private hospitals (16.6%).

*S. aureus*:
• 12 samples from private hospitals;
• 10 samples from public hospitals.

It was detected microorganisms in 18/20 samples (90%) from elastic tourniquets and 33/80 samples (41%) from rubber tourniquets.
In the same Research (S3 E6)

Questionnaire conducted to health professionals

- 96% of health professionals agreed that the hospital staff and fomites may spread infections;
- 44% (43 professionals) agreed that tourniquets can be a source of infection;
- 27% of the participants agreed that tourniquets contained blood spots;
- 2/3 mentioned that the tourniquet need to be clean before use;
- 25% agreed that the tourniquet should be washed before use.
Research conducted in two general hospitals belonging to the National Health System;
- Collected 34 samples of tourniquets non-sterilized and 36 tourniquets sterilized;
- Samples were placed on agar plates.

From 34 samples of non-sterilized tourniquets, 23 were contaminated with various microorganisms (63% from the non-sterilized tourniquets).

From 36 samples of sterilized tourniquets, none had associated contamination.
DISCUSSION

From the risk of contamination to infection

Nosocomial Infections

Data presented in 2008 the range was between 5% and 10%.

Pinto, et al. (2014) (S1, E1), estimates that 6% of hospitalized users will acquire nosocomial infections.

An increase of approximately 1.7%.

The Program of Prevention and Control of Infections reveals a prevalence of 11.7%.
Pinto, *et al.* (2014) (S1, E1) and Sahu, Tudu and Mall (2015) (S3, E4)

Both Researches refere that **inanimate objects existing in the hospital environment, are a source of transmission of microorganisms**, contributing to the **increased of nosocomial infections.**
Tourniquet as a possible source of transmission

Thompson et al. (2011) (S4, E7), Kim, Anh, Lee, and Chae (2014) (S2, E2), Sahu, Tudu, and Mall (2015) (S3, E4), Mehmood, Mubeen, Afzal and Hussain (2014) (S3, E6) and Pinto et al. (2011) (S1, E1)

Theese authors report that tourniquets are not disinfected or cleaned between use and they do not know if they have ever been replaced, reason to consider them a source of nosocomial infections.

Pinto et al. (2011) (S1, E1) and Sahu, Tudu, and Mall (2015) (S3, E4)

The contamination of tourniquets are majority attributed to hands of health professionals and not to the contact with patients (S1, E1) and that 61% of reusable tourniquets were colonized with species of microorganisms that weren’t associated with normal skin flora (S3, E4).

BUT…There is a colonization by bacteria and fungi, belonging to skin flora.

Kim, Anh, Lee, and Chae (2014) (S2, E2)
## Microorganisms found in the included Researches

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Articles/Researches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staphylococcus aureus</strong> Methicillin resistant (MRSA)</td>
<td>S1, E1; S3 E4; S3, E6</td>
</tr>
<tr>
<td><strong>S. aureus</strong></td>
<td>S2, E2; S3, E6; S4, E7</td>
</tr>
<tr>
<td><strong>Staphylococcus spp</strong> coagulase-negative</td>
<td>S1, E1; S3, E4; S4, E7</td>
</tr>
<tr>
<td><strong>Bacillus spp.</strong></td>
<td>S1, E1; S3, E4; S4, E7</td>
</tr>
<tr>
<td><strong>Pseudomonas spp.</strong></td>
<td>S1, E1; S3, E4; S4, E7</td>
</tr>
<tr>
<td><strong>Enterococcus spp.</strong></td>
<td>S1, E1; S3, E4</td>
</tr>
<tr>
<td>Tourniquets as a possible source of infection</td>
<td>Microorganisms found</td>
</tr>
<tr>
<td>---------------------------------------------</td>
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</tr>
<tr>
<td><strong>S1 E1</strong> Used in various patients without control of the contamination state.</td>
<td>17% of tourniquets – bacteria colonization corresponding to the skin flora.</td>
</tr>
<tr>
<td><strong>S2 E2</strong> Tourniquets rarely replaced.</td>
<td>At non-disinfected tourniquets, it is detected MRSA or VRE.</td>
</tr>
<tr>
<td><strong>S3 E4</strong> No desinfection after use.</td>
<td>At tourniquets non-sterilized MRSA and VRE was detect. It was also found <em>Staphylococcus spp.</em> and <em>Staphylococcus spp</em> coagulase-negative.</td>
</tr>
<tr>
<td><strong>S3 E6</strong> Used irrespective of infection status.</td>
<td>Tourniquets non-sterilized detected with MRSA and VRE. The prevalence of MRSA in public hospitals is higher than that in private hospitals. The prevalence of <em>S. aureus</em> in private hospitals is higher than that in public hospitals. Bacteria colonies is higher in reusable tourniquets than in disposable tourniquets.</td>
</tr>
<tr>
<td><strong>S4 E7</strong> Tourniquets rarely clean.</td>
<td>Non-sterilized tourniquets – infected with microorganisms.</td>
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Prevention measures and solutions

LIMITATIONS

• Shortage of professionals with specialized training;
• lack of Proper and adequate facilities of administrative support;
• Supporting infrastructure.
The big bet is on prevention!

Pinto et al. (2011) (S1, E1)  →  Disposable tourniquets

Kim, Anh, Lee, and Chae (2014) (S2, E2)  →  Personal hygiene;
Disinfection and sterilization of various materials (including tourniquets).

Sahu, Tudu, and Mall (2015) (S3, E4)  →  Antiseptics and disinfectants

Mehmood, Mubeen, Afzal and Hussain (2014) (S3, E6)  →  Lack of knowledge of health professionals

Thompson et al. (2011) (S4, E7)  →  Sterilized or disposable tourniquets;
Guidelines formulation for control of infection.
Therefore,

- We should have **prevention** as a main concern;
- **Disinfection and cleaning** of reusable tourniquets is one solution;
- Another solution is the use of **disposable** tourniquets;
- Do a correct **hand hygiene**.

**Important:**

The implementation of these strategies as a set of preventive measures and standards should be applied by a committee of infection control to improve the quality of care and hospital hygiene.
CONCLUSION

- Tourniquets are objects with the ability to become contaminated (fomites) and thus act as a vehicle of transmission of pathogenic microorganisms.

- **Responding to the research question:** the use of reusable tourniquets, associated with common practice, may be a risk to the safety of patients, in hospital hygiene, making fomites a risk of transmission of microorganisms.

- The viable solutions, consist in the use of disposable tourniquets and clean, disinfect or sterilize reusable tourniquets after their use.

- **It is important to continue updating our knowledge and its mobilization to the clinical practice of nursing.**

- The results of ILR can contribute to the encouragement of debate and research in this area.

- Other researches are suggested in order to investigate practices and to improve the knowledge that nurses has about use of tourniquets in clinical practice with the aim to prevent and control hospital infections.
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